# Cananga Flower (*Cananga Odorata*) Extract Gum's Efficacy In Reducing The Index Of Gingivitis-Causing Plaque Of Teuku Nyak Arif Fatih Bilingual School's Students

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## Abstrak

Prevalensi penderita gingivitis di Indonesia pada tahun 2018 mencapai 96,58%. Gingivitis adalah inflamasi pada jaringan gingiva akibat penumpukan plak dan bakteri *Porphyromonas gingivalis*. Penelitian oleh Anggraini (2021) menunjukkan bahwa tanaman yang berpotensi sebagai antibakteri terhadap *Porphyromonas gingivalis* adalah Kenanga (*Cananga odorata*). Permen karet dapat meningkatkan produksi saliva dan akan menetralkan asam oleh bakteri. Tujuan dari penelitian ini adalah untuk menawarkan produk alternatif pencegah gingivitis. Secara umum, penelitian ini melewati tiga tahap, yaitu uji in vitro, uji praklinis, dan uji klinis. Konsentrasi ekstrak bunga kenanga, yaitu 2,5%, 5%, 10%, 20%, dan 40% diuji potensi antibakterinya dengan metode difusi sumuran. Kontrol (+) adalah tetrasiklin 30 µg dan kontrol (-) etanol 96%. Uji praklinis dilakukan dengan metode *Brine Shrimp Lethality Test* untuk mengetahui *Lethal Concentration 50% ($LC_{50}$)*. Uji klinis dilakukan dengan metode *pretest and posttest control group design* selama seminggu. Berdasarkan hasil penelitian, rerata zona hambat pada konsentrasi 2,5%, 5%, 10%, 20%, dan 40% berturut – turut adalah 9,06 mm, 10,53 mm, 12,2 mm, 13,43 mm, dan 14,8 mm. Uji praklinis menunjukkan bahwa $LC_{50}$ dari bahan produk adalah 850,191 ppm. Hasil uji klinis berupa tingkat penurunan indeks plak, yaitu 0,344375 pada kelompok perlakuan. Penelitian ini menarik kesimpulan bahwa ekstrak bunga kenanga terbukti memiliki aktivitas antibakteri terhadap *Porphyromonas gingivalis* dan permen karet ekstrak bunga kenanga berpotensi efektif dalam mencegah dan menurunkan indeks plak penyebab gingivitis.

**Kata Kunci:** *kenanga; porphyromonas gingivalis; gingiviti;, permen karet; uji in vitro; uji praklinis; dan uji klinis*

## Abstract

In 2018, the percentage of Indonesians who have gingivitis was 96.58%. Accumulation of plaque and *Porphyromonas gingivalis* bacteria cause gingivitis, an inflammation of the gingival tissue. Cananga (*Cananga odorata*), according to research by Anggraini (2021), has an antibacterial activity against *Porphyromonas gingivalis*. Gum chewing can boost saliva production and reduce bacterial-produced acid. This study aimed to provide an alternative for gingivitis prevention. In general, the three steps of this research are in vitro test, preclinical test, and clinical test. Using the well diffusion method, the antibacterial potential of the cananga flower extract at concentrations of 2.5%, 5%, 10%, 20%, and 40% was examined. Tetracycline 30 µg was the control (+), while ethanol 96% was the control (-). In preclinical test, Lethal Concentration 50% ($LC_{50}$) was established using the Brine Shrimp Lethality Test (BSLT) method. The clinical test was done using a pretest and posttest control group design method for a week. According to the study's findings, the average inhibition zones were 9.06 mm, 10.53 mm, 12.2 mm, 13.43 mm, and 14.8 mm at doses of 2.5%, 5%, 10%, 20%, and 40%, respectively. Based on the

preclinical test, the product material's $LC_{50}$ is 850.191 ppm. The clinical test showed a decrease in the plaque index of the treatment group by 0.344375. This study concluded that cananga flower extract have antibacterial activity against *Porphyromonas gingivalis* and cananga flower extract chewing gum has the potential to be effective in preventing and lowering the plaque index that causes gingivitis.

Keywords: *cananga; porphyromonas gingivalis; gingivitis; chewing gum; in vitro test; preclinical test; clinical test*

## Introduction

Oral health is not sufficiently known among Indonesians. In 2018, 96.58% of Indonesians have gingivitis, according to the Ministry of Health. In Indonesia, 91.1% of people have brushed their teeth, yet only 7.3% of them do it correctly (1,2). Gingivitis refers to inflammation of the gingiva (gum) due to plaque buildup or biofilm formation, which is caused by the growth of bacteria on the gums, called *Porphyromonas gingivalis*, a Gram-negative bacterium. If it's left untreated, the risk of periodontitis will be increased, which is the next stage after gingivitis (3–6).

There's a beneficial endemic plant to Aceh, called cananga (*Cananga odorata*). Because of its secondary metabolites, it effectively inhibits *Porphyromonas gingivalis* growth (7,8). Chewing gum's advantages in the medical field have led to its widespread expansion. A number of illnesses can be lessened and treated with herbal gum (9). It helps to stimulate saliva production, which can neutralize the acid produced by the bacteria (10,11). The purpose of this study was to determine which cananga flower compounds inhibit *Porphyromonas gingivalis* growth and whether chewing gum products containing cananga flower extract effectively reduce plaque in order to prevent gingivitis. This is in line with the goals of the research, which include giving the public an alternative oral cleanser to help prevent gingivitis and raising the value of cananga plants in the health and economic sectors.

## Method

This study used the well diffusion method for in vitro testing and a Completely Randomized Design (CRD) for three repetitions in the laboratory. The Brine Shrimp Lethality Test (BSLT) was used for preclinical testing (toxicity test). The experimental pretest and posttest control group design method was used in the clinical test, also the Loe and Sillness measurement was used to calculate the plaque index score.

Flower samples were subjected to quantitative phytochemical testing using Gas Chromatography Mass Spectrometry (GC-MS) and flower extraction using the Soxhletation method. *Porphyromonas gingivalis* bacteria were first revived in vitro on Mueller Hinton Agar (MHA) medium using an inoculant suspension in accordance with the McFarland turbidity standard. The efficacy of several antibiotics was then assessed to identify the positive control. In order to determine extract's' efficacy against bacteria and inhibition zone formation, it was tested at extract concentrations of 2.5%, 5%, 10%, 20%, and 40%. As a negative control, 96% ethanol was used.

Preclinical test was performed to find the Lethal Concentration 50% ($LC_{50}$) of the product ingredients. Brine Shrimp Lethality Test (BSLT) was the chosen method and *Artemia salina* Leach larvae were used as the subjects. Test solution concentrations were prepared by mixing 100 µl of cananga flower extract, 900 µl of distilled water, and 5 gr of xylitol. The concentrations were 2000 ppm, 1000 ppm, 500 ppm, 250 ppm, 125 ppm, 62.5 ppm, 31,125 ppm, 7,781 ppm, and 0 ppm.

Chewing gum was the final product created from this research. Cananga extract used in the product had a low concentration but a high efficacy. It is created by mixing 6 gr of melted beeswax, 1 ml of cananga flower extract, and 5 gr of xylitol. Prior to undergoing clinical test, the Food and Drug Supervisory Agency (BPOM) tested cananga chewing gum for microbial contamination using *Salmonella typhii* bacterial contamination test parameters to guarantee the product's safety for consumption.

Pretest and posttest control group design was used in the clinical test. Using the Federer formula, the number of research samples was determined, and samples that satisfied the requirements for inclusion and exclusion in the treatment and control groups each comprised 16 individuals. The treatment group received cananga chewing gum while the control group received chewing gum without cananga extract.

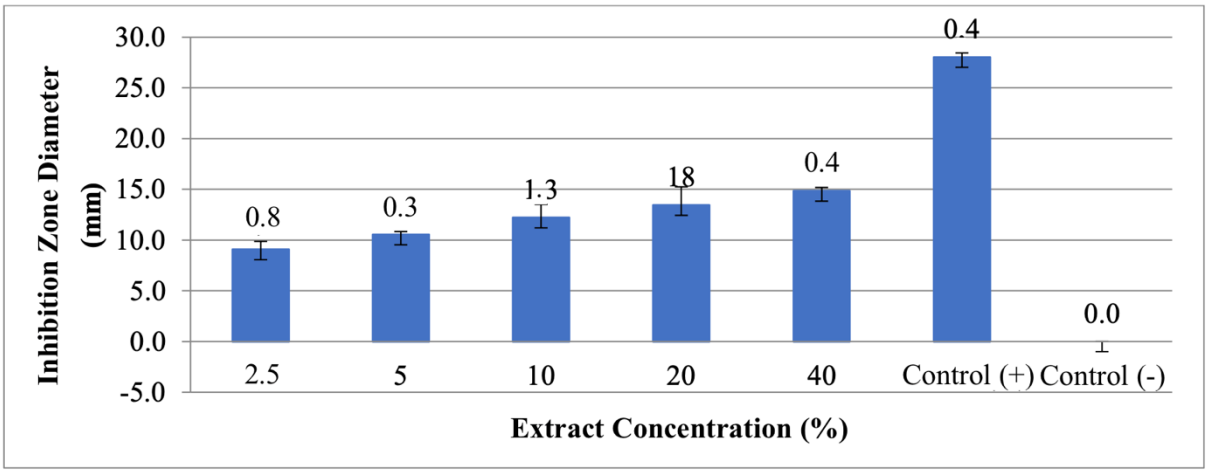
For one week, 32 students, ages sixteen to eighteen, participated in the clinical test. The clinical test started with an initial plaque index examination (pretest), which involved disclosing tablet chewing for 15 - 20 seconds. After that, the teeth's buccal, lingual, mesial, and distal surfaces were observed. Following the pretest, participants were instructed to chew gum according to the assigned groups. For a week, gum chewing was done twice a day for 2-3 minutes. A final index examination, also known

as a posttest, was conducted one week later to determine the quantity reduction of plaque and the Loe and Silness plaque index measurement was used to record the observation results.

**Results**

195 ml of extract were obtained from 20 gr of cananga flowers through the Soxhletation method. According to Gas Chromatography-Mass Spectrometry (GC-MS) test result, cananga flower extract contains the highest percentage of three chemical compounds. The largest compound found was Bicyclo [3.1.1] hept-2-ene, 2,6-dimethyl-6-(4-methyl-3pentenyl)-, at a retention time of 14.226 minutes at 15.183%. Caryophyllene was the second largest compound identified at a retention time of 13.235 at 14.36%. 1(2H)-Napthalenone, octahydro-4a,8a-dimethyl-7-(1-methylethyl)-, [4aR-4aα,7β,8aα)] was the third largest compound found at a retention time of 16.045 minutes at 13.41%.

Extract's antibacterial efficacy test result is inhibition zone diameter of each concentration and it is shown graphically along with the standard deviation to show how the data are distributed. Every concentration of cananga flower extract contains an inhibition zone against *Porphyromonas gingivalis* bacteria. (**Graph 1**)




**Graph 1** Extract's Inhibition Zone Diameter and Standard Deviation

The results of preclinical tests on *Artemia salina* Leach shrimp larvae using the BSLT method was obtained from the examination of the number of dead *Artemia salina* Leach shrimp larvae using SPSS to determine the $LC_{50}$ value. The $LC_{50}$ value was

found at a concentration of 850.191 ppm. The chewing gum contains a mixture that includes 10% cananga flower extract. Based on the results of the extract's antibacterial efficacy test, a concentration of 10% is the small but has great antibacterial efficacy. **(Figure 1)**


**Figure 1** Cananga Chewing Gum

Microbial contamination test using *Salmonella typii* test parameter produced negative results for the cananga chewing gum. Following the issuance of microbial contamination test results, clinical test was conducted. The findings of the study on the two groups' plaque index reduction during a one-week test period are displayed in **Table 1**.

| Chewing Gum | Tests | Control | Treatment |
|---|---|---|---|
| Plaque Index | Pretest | 1.864375 | 1.9896975 |
| | Posttest | 1.8340625 | 1.6453125 |

Table 1 Initial and Final Plaque Index Average

**Discussion**

Gas Chromatography Mass Spectrometry (GC-MS) quantitative phytochemical test revealed that there are three chemical compounds with the highest area percentage.

They are Bicyclo [3.1.1] hept-2-ene, 2,6-dimethyl-6-(4-methyl-3-pentenyl)- and caryophyllene with respective area percentages of 15.83% and 14.36%, which are classified as sesquiterpenes. Also, 1(2H)-Napthalenone, octahydro-4a,8a-dimethyl-7-(1-methylethyl)-, [4aR-4aα,7β,8aα)] at 13.41% which classified as sesquiterpenoid. Terpenoid compounds include sesquiterpenes and sesquiterpenoids. (12–15).

The compounds found in cananga flower extract, known as sesquiterpenes, possess potential antimicrobial, antifungal, and antibiotic properties (16,17). Gram negative bacteria like *Pophyromonas gingivalis* are particularly susceptible to the antibacterial properties of terpenoids (13). The inhibition zones formed were the result of cananga flower extract's antibacterial efficacy test against *Porphyromonas gingivalis*. These findings suggested that the increase in inhibition zones formed and extract concentration were directly proportional.

According to preclinical test results, the concentration of product ingredients that can have a toxic effect is 850.191 ppm, which is the concentration that can kill 50% of the subjects after 24 hours of treatment. From the clinical test results, it was seen that the plaque index decreased in the treatment group by 0.344375. This showed that cananga chewing gum has proven to be potentially effective in reducing plaque that causes gingivitis. This is in accordance with research which stated that cananga essential oil, which has been utilized as a medication for periodontal disease, effectively lowers the plaque index by preventing the development of biofilm on the tooth surface, eliminating bacteria, and acting as an anti-inflammatory (18). It’s concluded that cananga flower extract has antibiofilm properties.

## Conclusion and Suggestion

From the research, the author drew the conclusions that cananga chewing gum can lower the treatment group's plaque index by 0.344375 and cananga flower extract has anti-biofilm properties. In order to conduct more research on the application of clinical test, male research subjects and more various ages could be included, as well as a longer implementation period and a more thorough technical implementation of the clinical test.

**References**


1. Nita AA, Edi IS, Isnanto I. Kejadian Gingivitis Pada Ibu Hamil Ditinjau Dari Faktor Hormon, Perilaku Dan Lokal. Jurnal Kesehatan Gigi dan Mulut (JKGM). 2021;3(2):41–6.
2. Winarto Putri W, Nina N. Hubungan Antara Frekuensi Menyikat Gigi, Cara Menyikat Gigi dan Kebiasaan Makan dengan Kejadian Karies. Journal of Public Health Education. 2021;1(01):13–9.
3. Devi, Fortuna PA. Pengetahuan Tentang Gingivitis Pada Ibu Hamil Di Kabupaten Gianyar. 2021;4(1):1–23.
4. Muttaqien DA. Efektivitas Ekstrak Daun Belimbing Wuluh (Averhoe Bilimbii L) Terhadap Pertumbuhan Bakteri Porphyromonas Gingivalis Secara In Vitro. 2018;11.
5. Kasuma N. Plak Gigi [Internet]. Vol. 1, Pengaruh Penggunaan Pasta Labu Kuning (Cucurbita Moschata) Untuk Substitusi Tepung Terigu Dengan Penambahan Tepung Angkak Dalam Pembuatan Mie Kering. 2016. 165–175 p. Available from: https://core.ac.uk/download/pdf/196255896.pdf
6. Rohmah NF. Faktor-Faktor Yang Mempengaruhi Hubungan Tingkat Pengetahuan Kesehatan Gigi Dan Mulut Pada Mahasiswa Kedokteran Gigi Unimus Angkatan 2013, 2014, 2015 Terhadap Indeks Plak. J Chem Inf Model [Internet]. 2017;120(11):259. Available from: http://repository.unimus.ac.id/id/eprint/1352
7. Sumarini, Bayu Aji N, Solekan. Pengaruh Volume Air Dan Berat Bahan Pada Penyulingan Minyak Atsiri. J Teknol. 2008;1(1):83–8.
8. Rahma Yulis PA, Aisyah meiysa putri, Anasthasia oca muham, Silvia anggraini, Siti maisarmah. Analisis Kualitatif Kandungan Bunga Kenanga (Cananga Odorata) Secara Fitokimia Dengan Menggunakan Pelarut Etanol. Journal of Research and Education Chemistry. 2020;2(1):43.
9. Khairiah N, Prabawa IDGP, Hamdi S, Rahmi N. Aplikasi ekstrak sarang semut sebagai senyawa antimikroba dan antioksidan pada permen karet herbal [Application of ant nests (Myrmecodia sp.) extract as antimicrobial and antioxidant compounds in herbal gum]. Jurnal Riset Industri Hasil Hutan. 2019;11(1):31.
10. Fatiharani Dewi P. The effect of xylitol containing chewing gum consumption on dental plaque forming. 2008;
11. Sandra P, Allioes Y, Susi S. Pengaruh Pengunyahan Permen Karet Yang Mengandung Xylitol Terhadap Penurunan Indeks Plak Pada Perokok. Andalas Dental Journal. 2015;3(2):95–104.
12. PubChem [Internet]. Bethesda (MD): National Library of Medicine (US) NC for BI. National Center for Biotechnology Information. 2023. PubChem Compound Summary for CID 86608, alpha-Bergamotene. Available from: https://pubchem.ncbi.nlm.nih.gov/compound/alpha-Bergamotene
13. Guimarães AC, Meireles LM, Lemos MF, Guimarães MCC, Endringer DC, Fronza M, et al. Antibacterial activity of terpenes and terpenoids present in essential oils. Molecules. 2019;24(13):1–12.
14. ChemSpider. ChemSpider. Valeranone | C15H26O | ChemSpider. Available from: https://www.chemspider.com/Chemical-Structure.149890.html

15. Rucker G, Tautges J, Sieck A, Wenzl H, Graf E. Vol. 28, Arzneimittel-Forschung. 1978. p. 7–13 [Isolation and pharmacodynamic activity of the sesquiterpene valeranone from Nardostachys jatamansi DC].
16. Anggaraini I. Kadar Hambat Minimum (Khm) Dan Kadar Bunuh Minimum (Kbm) Pada Bunga Kenanga (Cananga Odorata (Lam.) Hook F. & Thomson) Terhadap Bakteri Porphyromonas Gingivalis Secara In Vitro. B-Dent: Jurnal Kedokteran Gigi Universitas Baiturrahmah. 2021;7(2):162–9.
17. Maulidya R, Aisyah Y, Haryani S. The Effect Of Flowers Types and Picking Time On Physicochemical Properties and Antibacterial Activity Of Cananga Oil (Cananga odorata). Jurnal Teknologi dan Industri Pertanian Indonesia [Internet]. 2016;08(02):53–60. Available from: http://jurnal.unsyiah.ac.id/TIPI
18. Singh I, Kaur P, Kaushal U, Kaur V, Shekhar N. Essential oils in treatment and management of dental diseases. Biointerface Res Appl Chem. 2022;12(6):7267–86.